jet is returned back again: and although the efficiency is small, when compared with a pump, still the Injector has the advantage of working while the engine is at rest.

The same principle is applied occasionally in the Water Injector and the Ejector, where, for instance, a large body of water, in the form of leakage or water ballast, is to be rapidly cleared out. A somewhat similar instrument, although quite different in principle, is that called the Pulsometer, which is really a revival of the Marquis of Worcester's and Savory's Fire Engine, where the pressure of steam acts directly on the surface of the water. To check the great condensation a piston was introduced, and hence our modern steam engine.

Hot Air Engines are described in chapter xi., and here the mathematical theorems for Perfect Gases receive their most beautiful applications, so that formal treatises on Thermodynamics usually treat this part of the subject at length. Our author dismisses it in about eight pages, with a short description of the principal systems, as, unfortunately, all the practical objections against the use of Superheated Steam are intensified tenfold in the Hot Air Engine. Ericsson once fitted a steamer to cross the Atlantic with engines on this principle: they were very cumbrous although the boilers were dispensed with; and the experiment did not lead to further imitation. An exception must be made in favour of the Gas Engine, as the only practical application of the Hot Air Engine; the author works out the theory, and comes to the remarkable conclusion that the efficiency of the Gas Engine Cycle does not depend, as in ordinary Thermodynamics, on the difference of temperatures so much as on the degree of expansion and compression.

The author reaches the real part of his subject in chapter xii., where he discusses the theory of the Actual Steam Engine, as we really find it working, in the mill, mine, and on the railway or steamer.

Here Hirn appears as the great authority on the careful records of what takes place in the actual engine (chapter xvii.).

> "The measurement of quantities of heat, especially when it has to be done in an engine at work, is an operation of great difficulty; and it was not till 1862 that it was shown experimentally by Hirn that h, the heat emitted, is really less than H, the heat received by the engine" (Maxwell, "Theory of Heat").

The example of Hirn has been followed up of recent years by careful and long-continued experiments on steamers and pumping engines in regular work, and the results of the most important of these tests receive careful description and analysis, in chapters xv.-xviii.; a preliminary chapter, xiv., giving a detailed account of the best procedure and instruments required in Testing Steam Engines.

The book will be found indispensable, not only by designers of Steam Engines, but also by writers of abstract treatises on Thermodynamics, as restraining their mathematical development within reasonable limits of actuality, and as directing their analytical powers in a useful direction.

A. G. GREENHILL.

BRITISH FLIES.

An Account of British Flies (Diptera). By the Hon. M. Cordelia E. Leigh, F.E.S., and F. V. Theobald, B.A., F.E.S. Vol. I., Part I. (London: Elliot Stock, 1891.)

THE reader involuntarily glances back at the title of this work when the first words that meet his eye on the front page are: "One of the branches of science that has advanced with rapid strides during recent years is geology. . . ." To commence with Fossil Diptera, and to enumerate the families (and some of the genera) members of which are found preserved in the earth's strata, before either families or genera have been in the least degree defined, is a somewhat novel way of beginning. When the work is completed, students will find it useful to transfer chapter i. to the end. The second chapter, entitled "Classification of Diptera, with an introductory account of the ancient and modern classification of Insecta," contains much matter of interest to entomologists in general, although it is questionable whether the authors have arranged their material in either the most attractive or the most methodical form. The classification of the Diptera it is intended to follow is that of Verrall, published in 1888, in which the order is divided into two great sections—the Orthorrhapha and the Cyclorrhapha; the Nematocera and Brachycera being included in the former, and the Proboscidea with the Eproboscidea in the latter. The Aphaniptera (now included in Nematocera) form the subject of the third chapter, in the course of which this first part terminates. The structure and metamorphosis of Pulex are discussed at some length, and certain species are described in detail. Some uncertainty seems to exist in the authors' minds as to how many of them are engaged upon the work, for they use both "we" and "I." This calls to the recollection Cruikshank's picture, "In which there is Antagonism of interest yet Mutuality of object."

It is not possible from a perusal of the first thirty-two pages to form a fair idea as to the general character of the work. It may be stated, however, that it appears to be written for those who are already entomologists, a familiarity with entomological science on the part of the reader being assumed by the authors. Considerable trouble has evidently been taken in consulting authorities whose works are accessible only to the few. That there is plenty of room for a good treatise on the British Diptera will readily be admitted, and if the authors should have something new to tell about such genera as Chlorops, Oscinis, Cecidomyia, and Hylemyia, so much the better. Part I. is illustrated by five woodcuts.

OUR BOOK SHELF.

Principles of Agriculture. Edited by R. P. Wright, F.H.A.S. (London: Blackie and Son, 1891.)

THE *raison d'être* of this little volume is to be found in its "tail," where are reproduced the questions set in the Science and Art Department Examinations in the Principles of Agriculture during the last eleven years. The title-page ought to state, but it does not, that this is a revised edition of a book that was published some years ago. This fact is only discoverable from the preface. The original edition was arranged in three

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parts, whilst the current edition is in four parts. The added part is somewhat of a jumble, inasmuch as it is supplementary of each of the first three parts. The scheme of the book is not apparent from the list of contents, and this omission results in confusion. Whilst, however, the arrangement of the book is bad, the matter is good. In skilful hands, indeed, the material which is here accumulated might have been very attractively presented. At p. 132, a dozen pages are commenced on the pests of the farm, whilst another dozen pages devoted to the same subject begin on p. 180. At p. 71, the reader enters upon 30 pages about manures, and at p. 167 he gets a further dozen pages also upon manures. And so on.

With reference to the fixation of nitrogen by leguminous plants, mention is made of the presence on the roots of these plants of "little bag-like enlargements, or *tubercles* as they are called." It is unfortunate that this effort should be made to associate the pathological term "tubercle" with these structures. The word "nodule" is much preferable, and is not less explanatory.

Despite the fact that the book has been written to enable candidates to "pass an examination," it is as useful and trustworthy a little treatise of the kind as we have seen.

Elementary Trigonometry. By J. M. Dyer and Rev. R. H. Whitcombe. (London: George Bell, 1891.)

THE title of this book is on all fours with the contents. The work is well adapted for school use. The explanations of book-work are clearly expressed, and the text is amply illustrated by a store of exercises. Sufficient ground is covered to meet the wants of average Army pupils.

We have detected errata in the text on pp. 21, 30, 36, 59, 61, 62, 65, 67, 74, 80, 101, 136, 153. The major part of the proof-sheets has been carefully gone over, but occasionally, as we have indicated, the authors have nodded. The printing in places, in our copy, is defective. But these faults only slightly mar a work which treats a hackneyed subject with all the freshness one can look for in an elementary text-book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Opportunity for a Naturalist.

SINCE the completion of "Argentine Ornithology," in which was given an account of the 434 species of birds then known to occur in the Argentine Republic, Mr. Arthur Holland, of the *Estancia Espartilla*, and Mr. J. Graham Kerr, of the Pilcomayo Expedition, have made excellent contributions to the same subject, and have added some 30 species to the Argentine avifauna. But much more remains to be done, and, in continuation of the work, I am now anxious to get a good series of birds from Uruguay, the fauna of which, so far as we know it, does not appear to differ materially from that of its neighbouring Republic. For this purpose I have made arrangements with a friend to take in a naturalist at his *Estancia*, near Minas, about sixty miles from Monte Video, and am looking for a qualified collector to occupy the post. His necessary expenses will be met, but his further remuneration must depend, more or less, on the results obtained. May I ask the aid of NATURE to make known this eligible opportunity for a young naturalist who can make good birds'-skins, and is anxious to pass a few months in a foreign clime? P. L. SCLATER.

3 Hanover Square, London, W.

Warning Colours.

MR. BEDDARD, in his letter published in NATURE of November 26 (p. 78), calls attention to Dr. Eisig's suggestion that those bright colours of animals which have hitherto been regarded as of warning significance are merely the substances which confer the unpleasant taste, and that therefore the older interpretation is unnecessary and in fact erroneous. The writer furthermore implies that Dr. Eisig's views are not alluded to by those who have written upon animal colours, because they have escaped their attention. There is, however, another possible explanation of such neglect, and one which in my own case is certainly the correct one—viz. that the views in question appear to be so inherently improbable that a large body of confirmatory evidence is required before they demand attention. I do not by this mean to suggest that the unpalatable attribute may not possess a bright colour: this is certainly often the case, especially with the secretions expelled by many insects when they are irritated. But it is highly improbable that these facts afford any refutation of the theory of "warning colours"—that is, of the view which regards the bright and conspicuous colouring as an indication (in mimetic forms a false indication) of some unpleasant attribute, whether associated or unassociated with the colour itself. And as regards the bright colours of Lepidopterous *imagines*, such association is, to say the least of it, entirely unproved. It by no means follows that the yellow colouring of the brimstone and other butterflies is disagreeable in flavour because it "is due to a substance formed as a urinary pigment." And the relation of many animal colours to these pigments by no means necessarily implies unpalatability. Again, it would be impossible to regard merely as a coincidence the fact that the substances in question almost invariably produce a conspicuous appearance, and, furthermore, produce it in a variety of ways. Such an appearance is, as is well known, not merely due to the individual colours, but to their mutual arrangement and relationship. It is due, moreover, to a variety of physical principles, for the production of white is very different from the production of the colours which are so often contrasted with it. Conspicuous effects are furthermore often gained without the use of pigment, as in the brilliantly metallic pupæ of *Euplœa core* and of *Mechanitis lysimnia.* Hence the contention that the bright colour of distasteful insects is a mere incident of chemical composition which has been selected on other accounts is so inherently improbable that it would require a large body of evidence to support it.

But perhaps the strongest argument against the view is that it creates such an artificial distinction between inedibility due to mere unpalatability, and that due to other unpleasant attributes. Mr. Beddard would probably admit that the conspicuous colouring of the skunk, the coral snake, and the wasp possesses a true warning significance; and yet he would interpret the black and yellow colouring of the larva of the cinnabar moth or the pupa of the magpie moth (both known to be unpatable) in an entirely different way, and would deny that it possesses a warning meaning.

In addition to these considerations, the undoubted existence of an unpalatable quality not residing in the superficial pigments is quite clear in many brightly coloured insects. The irritating hairs and odoriferous secretions of many Lepidopterous and Hymenopterous larvæ, and the evil-smelling yellow fluids which exude from *Coccinellidæ* and from many conspicuous butterflies are examples.

The recent investigations of the distinguished Russian naturalist Portchinsky (II. "Coloration marquante et taches ocellées, leur origine et leur développement," St. Petersburg, 1890) have, among other things, shown us the distinct manner in which the colours which attend unpalatability are displayed by the insect when it is disturbed. He thus explains some of the cases of "shamming death" which are so often alluded to in works on insects (the other cases being explained by the necessity for concealment). Two examples which he adduces are so interesting, and have so important a bearing on this discussion, that I cannot resist the temptation of reproducing them here, especially as Portchinsky's paper, being written in Russian, is almost unknown in this country. I have, however, been most kindly helped by my friend Mr. Morfill, and now possess a complete translation, which I hope soon to publish. The female of *Spilosoma mendica* possesses black and yellow legs, and, when disturbed, it folds its limbs and drops to the ground, generally falling on its back, so that the contrasted colours are displayed (see Fig. 1). In the closely allied *Spilosoma urticæ* the dorsal surface of the abdomen is black and yellow, and this insect, when irritated, raises its wings and curves the abdomen downwards so that the colour is conspicuous. Furthermore,

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